ENCYCLOPEDIA OF HUMAN BEHAVIOUR, 2ND EDITION

Author and Co-author Contact Information

Michael Smithson

Department of Psychology, The Australian National University

Canberra A.C.T. 0200 Australia

Michael.Smithson@anu.edu.au

P: 61-2-6125-8356

F: 61-2-6125-0499

**Abstract**

The human sciences have issued two broad streams of theory and research on uncertainty. One of these springs from the psychology of judgment and decision making and behavioral economics. The other stems from sociology and social anthropology. This article surveys both. The first section deals with conceptualizations of uncertainty and related notions. The second focuses on how people perceive and make judgments about uncertainties. The third considers ways in which unknowns are socially constructed. The primary theses here are that people act as if there are different kinds of uncertainty and uncertainty plays "positive" as well as "negative" roles.

**Keywords**

ambiguity, belief, decision, error, fuzziness, ignorance, irrelevance, judgment, nescience, nonknowledge, probability, taboo, uncertainty, unknown, vagueness

**Glossary**

Ambiguity: A special kind of uncertainty. A concept or proposition is ambiguous if it has two or more distinct possible meanings.

Fuzziness: A special kind of vagueness that refers to graded degrees of membership in a set.

Ignorance: A is ignorant from B's viewpoint if A fails to agree with or show awareness of ideas which B defines as actually or potentially valid. Ignorance has a passive sense (being ignorant of X) and an active sense (ignoring X).

Irrelevance: X is considered irrelevant iff X is considered unrelated to Y. Irrelevance therefore leads to X being ignored when considering Y.

Nescience: A complete lack of knowledge.

Risk: Composed of ignorance and the prospect of loss. In economics, risk is composed of probability and the prospect of loss.

Uncertainty: A special kind of ignorance, namely incompleteness of information. There are nonprobabilistic as well as probabilistic kinds of uncertainty.

Vagueness: A special kind of uncertainty. A concept is vague if its possible meanings extend over a range on a continuum.

**Body text**

Uncertainty may be defined as a particular kind of unknown, namely incompleteness of information. Incompleteness, in turn, can take various forms, such as simple absence, ambiguity, or even probabilistic uncertainty. Uncertainty, above all, is a mental state, and it can arise either from incomprehension (not understanding an entity or event) or indecision (not knowing what to do). The human sciences have issued two broad streams of theory and research on uncertainty. One of these springs from the psychology of judgment and decision making and behavioral economics. The other stems from sociology and social anthropology. This article incorporates both in its overview. Most of the work on uncertainty has focused on incomprehension although in recent years indecision has been paid more attention, especially in psychology and behavioral economics.

## I. Concepts and Definitions

Uncertainty is a topic that does not fall neatly within a single discipline. Instead it sprawls across a considerable variety of disciplines, professions, and problem domains. Many disciplines and professions have (often implicit) assumptions and beliefs about the unknown, but these are not integrated with one another. Consequently, there is no cogent, readily identifiable body of literature on uncertainty. It is also difficult to communicate clearly about uncertainty, and the scattered literature on this topic understandably lacks an agreed-upon nomenclature. The absence of a standardized terminology for this domain thwarts sophisticated work.

Nevertheless, several disciplines have proposed terminologies for uncertainty and related concepts. Some also have produced worthwhile distinctions among kinds of uncertainty, and even attempts at exhaustive classification systems. We begin by briefly reviewing these attempts at nomenclature, definitions and taxonomic schemes.

### A. Terminology and Classification

Let us start by considering a term for the overarching concept in this domain. An early proposal is the German word “nichtwissen,” whose English equivalent is “nonknowledge.” A related, if less common, term is “nescience” (total ignorance). Outside the social sciences the most popular general term seems to be “uncertainty.” This is the case, for example, in psychology, economics, and engineering. Still another alternative is “ignorance” itself, which I will use as the over-arching term in this article, taking “uncertainty” to be a subset term when it is necessary to make that distinction.

A major problem in choosing a name for the unknown and attaching a definition to it is that we cannot avoid making claims to know something about who is ignorant of what. Any claim about ignorance entails a knowledge-claim regarding the nature of said ignorance. A definition that seems to handle these problems reasonably well is as follows: A is ignorant from B's viewpoint if A fails to agree with or show awareness of ideas which B defines as actually or potentially valid. This definition allows B to define what she or he means by ignorance. It also permits self-attributed ignorance, since A and B may be the same person. Most importantly, it incorporates anything B thinks A could or should know (but doesn't) and anything that B thinks A must not know (and doesn't). B’s notions about ignorance may be as context-dependent and subjective as required.

The intuition that there might be different kinds of ignorance has motivated a number of scholars to propose various distinctions and taxonomies. One of the most popular distinctions is absence or neglect versus distortion. Another common distinction is reducible versus irreducible ignorance. The term “negative knowledge” has been proposed to encompass knowledge of the limits of knowing, mistakes in attempts to know, things that interfere with knowing, and what people do not want to

know. A fourth distinction in some languages is between the active voice (ignoring) from the passive voice (being ignorant).

Several taxonomies of ignorance have emphasized distinctions that operate at a meta-level rather than describing the nature of different kinds of ignorance per se. The most popular distinction is between knowing that we don't know (conscious ignorance) and not knowing that we don't know (meta-ignorance). A related distinction is between knowing that we know something versus not knowing that we know it (tacit knowledge).

Some disciplines have produced relatively sophisticated and productive distinctions among special kinds of ignorance and uncertainty. In mathematics, besides at least three major schools of probability theory, several different kinds of uncertainty formalisms have been proposed such as fuzzy set theory, belief functions, and imprecise probability theories.

The most useful high-level distinctions that have emerged from the human sciences are threefold. First, the meta-level concepts of meta-ignorance versus conscious ignorance are crucial. Second, there is the important distinction between ignorance and "negative knowledge" in the sense of knowledge about the limits of what can or should be known. Finally, the active versus passive voice distinction is important. The active voice (to ignore) shall be referred to as "irrelevance" and the passive voice (to be ignorant of) as "error."

Lower-level distinctions among kinds of error that have proven useful are as follows. Error may arise either from incomplete or distorted views, or both. Distortion may consist of a systematic bias or inaccuracy (e.g., under- or over-estimation), or confusion (mistaking one thing for another). Incompleteness in kind is outright absence of information, whereas incompleteness in degree constitutes what we shall term "uncertainty." Uncertainty, in turn, includes probability, vagueness, ambiguity, and conflict. These are terms we shall explore further.

Aside from a priori distinctions and classifications, how can we assess what other distinctions are worth making, especially those intended to represent localized meanings and usages? I suggest four criteria, namely whether candidate kinds of ignorance or uncertainty:

1. Are consistently distinguished from other kinds when referred to in communication by members of the same linguistic community;
2. Are accorded statuses or roles distinct from other kinds in the same situations or for the same purposes in social interaction,
3. Produce different social consequences for those to whom they are attributed, and/or
4. Are (dis)preferred to other kinds.

These criteria are useful in helping students of uncertainty to remember that lawyers use "probability" differently from statisticians, that for many people conveying outright misinformation (i.e., distortion or lying) is morally worse than conveying vague or partial information, and so on.

## B. Schools of Probability

Many reviews of probability theories divide schools of probability into three camps: Logical or a priori probability, frequentist probability and Bayesian probability. All three schools agree on the probability calculus; where they differ is on the basis and scope of probability. The a priori theory is exemplified in games of chance, where idealized fair gaming devices such as dice and cards are employed for bets on outcomes whose probabilities are known beforehand. Probabilities of this kind

are based on the principle of indifference, which defines the probability of an event as the ratio of "favourable" cases to the number of all "equipossible" cases.

The frequentist theory begins with the premise that under repeated trials under identical conditions, the probability of an event is estimate by the relative frequency with which it occurs out of the number of trials. According to various versions of the strong law of large numbers, the relative frequency converges to the true probability as the number of trials tends toward infinity.

Neither the a priori nor the frequentist frameworks admit such concepts as the probability of a unique event or a subjective probability. Both approaches limit the scope of probability theory to "objective" likelihoods of repeatable events. The Bayesian theory does extend probability to subjective appraisals and unique events, by identifying subjective probabilities with degrees of belief that obey the laws of probability. For events whose likelihood can be assessed by accumulating evidence (e.g., via repeated trials), Bayes' theorem is employed to update prior probability judgments on the basis of new (perhaps objective) evidence.

In the 1970s and 1980s, the Bayesian approach gained prominence in fields concerned with the mental representation of uncertainty, such as cognitive psychology, behavioral economics, artificial intelligence, and knowledge engineering. Subjective Bayesians claim their approach ensures that decision makers behave rationally in accordance with their beliefs about event likelihoods. This claim is based on an extensive normative framework for decision making under uncertainty, subjective expected utility (SEU) theory. The central tenet of this theory is that the expected utility of an event is its "utility" multiplied by its probability. Utility is presumed to be a scalar quantity (e.g., money), and a rational agent chooses the option that maximizes their expected utility. For instance, given a choice between a gamble with probability of .5 of getting $20 and a gamble with probability of .25 of getting $32, the choice that would maximize expected utility is the first gamble (.5*$20 = $10, whereas .25*$32 = $8).

Until the 1990s, frequentist probability theory dominated statistical theory and applications, partly due to its familiarity for statisticians and partly because of the seemingly impractical computational demands of Bayesian statistical modeling. This state of affairs changed with increases in computing power and the development of Markov Chain Monte Carlo methods for Bayesian models. These developments enabled the application of Bayesian methods to complex models. Currently, Bayesian statistical modeling is increasing in accessibility and popularity.

Uncertainty research in psychology and behavioral economics over the past four decades has featured extensive comparisons between the SEU framework and the ways that humans think about probability (see section II of this chapter). For some time, SEU was considered the arbitrator of "rational" decision making and, therefore, Bayesian probability theory the normative standard for uncertainty judgments. As we shall see in section II, recent developments have shifted away from both of these positions.

### C. Nonprobabilistic Uncertainty

The claim that there is more to uncertainty than probability has a fairly lengthy history. One of the earliest is Max Black's classic distinctions among vagueness, generality (or nonspecificity), and ambiguity. An earlier distinction was drawn by Keynes and Knight between "risk" (where probabilities are known) and "uncertainty" (where probabilities are imprecise or unknown).

During the past four decades there has been a rapid proliferation of alternative frameworks for dealing with uncertainty in formal or mathematical ways that depart from standard probability

theory. Fuzzy set theory, roughs sets, and fuzzy logic have been developed as frameworks for dealing with vagueness and related kinds of nonprobabilistic uncertainty. The primary claim for fuzzy set theory is that it handles categories (sets) in which items can have partial membership (e.g., a "reddish" color or a "tall" person). Likewise, fuzzy logic permits degrees of truth to be attached to propositions.

Probability theory itself has been generalized to incorporate vagueness, mainly by extensions to "imprecise" probabilities. Formalisms of this kind include possibility theory, Dempster-Shafer belief theory, and several theories of imprecise probabilities that incorporate these two as special cases. The past two decades have seen the establishment of these frameworks on firm axiomatic foundations and an increasing number of applications. Nevertheless, these developments have been controversial at times and there are ongoing debates over what properties generalized probability theories should have.

## II. Perception and Judgment

Psychology is one of the few disciplines that attempts to account for how people perceive and respond to uncertainty. These accounts have been useful in behavioral economics, management science, risk management and a host of other areas. Psychological theories about uncertainty fall into two groups: how people manage in an uncertain world, and how people manage uncertainty itself. This section deals primarily with the latter.

There are, broadly speaking, three traditional normative orientations regarding how people deal with the unknown in psychology, and each has its roots in particular theoretical developments. Perhaps the oldest is the "Knowledge Seeker," originating in the psychoanalytic canons for the well-adjusted individual and found in most branches of ego psychology. This view extols the person who seeks novel information and experience, is open to full and honest communication, can tolerate uncertainty and even ignorance in the short run in order to gain knowledge, and who is not defensive about prior beliefs.

The second tradition, the "Certainty Maximizer," focuses on the debilitating consequences of uncertainty, unpredictability, and uncontrollability for the affective, cognitive, and physiological capabilities of the affected organism. Most of the evidence for this viewpoint originates from research on learning and adaptation. But an entire set of emotion-based theories also assumes that anxiety is a consequence of uncertainty. Likewise, several social psychological and communication theories of human interaction assume that people are motivated to reduce uncertainty. Thus, there is a natural tension between this tradition and that of the "Knowledge Seeker."

The third tradition, the "Intuitive Statistician-Economist," originates from psychophysics, perception, and cognitive psychology, and reflects information processing models of cognition. It is primarily concerned with criteria for rationality in judgment and choice, and the dominant normative viewpoints have been probability theory and a view of humans as hedonic (seeking pleasure and avoiding pain). This view has a lot in common with neo-classical economics. "Rational" decision makers estimate probabilities, quantify utilities and make choices according to the precepts of SEU. Given this prescriptive benchmark, much of the research in this tradition has focused on judgmental and decisional errors, in the sense of deviations by people from this allegedly rational prescription.

Psychological research on judgement and decision making under uncertainty has stimulated lively debates about the nature of rationality and the extent to which humans can be shown to be rational or irrational. Proponents of the view that humans are not rational fall into the "heuristics and

biases" camp, and their primary claims are that the mental shortcuts to reasoning (heuristics) that people use cause them to fall prey to irrational tendencies (biases). The "bounded rationality" camp, on the other hand, characterizes human judgment as rational under the constraints of limited time and cognitive capacity, employing "fast and frugal" heuristics to cope with such constraints. Moreover, some members of this camp claim that many so-called heuristics are adaptive, because they exploit correlated structure in the environment. Finally, in recent times more attention has been paid by some researchers to the role of emotion in guiding judgements and decisions. Their major claim is that emotions may be essential for making good decisions under uncertainty.

## A. Judgmental Biases and Errors

The "heuristics and biases" style of research on uncertainty judgments peaked in popularity during the 1980s, with popular treatments appearing in the subsequent two decades. One textbook during this time identified 27 cognitive errors in human judgments about uncertainty. In a few countries, proposals were even mooted to incorporate corrective training in probability judgments into educational curricula.

One class of biases and errors pertains to selective neglect of relevant information. This class includes a ignoring or discounting negative and/or disconfirming evidence (confirmation bias), ignoring base-rate information about probabilities in favor of less relevant information (base-rate fallacy), and ignoring sample size in accounting for variation (sample size fallacy).

A second class pertains to judgments regarding random processes. The most famous is gambler's fallacy, an under-estimation of the length of runs in random processes coupled with a belief that random variation "balances out" in a self-correcting fashion. A related phenomenon is the under-estimation of subjective confidence interval widths, yielding over-confidence when these confidence intervals are used for prediction. Several studies of gambling behvior also have found that at least some people believe they have control over random events (e.g., in games of chance). Set against these findings is another collection of studies demonstrating that people are too conservative in readjusting their estimates of an event's likelihood when presented with new evidence (anchoring and adjustment). However, during the 1990s several studies found that humans are able to make fairly accurate short-term predictions of low-dimensional deterministic chaotic processes, from which it was suggested that people respond to random processes as if they are a particular kind of chaotic process.

A third kind of error concerns conditional probabilities and probabilities of compound events. The most famous of these is the "conjunction fallacy," a violation of the rule that $P(A\&B) \leq \min(P(A), P(B))$. Other well-established examples include the disjunction fallacy and violations of additivity (the rule that probabilities of an exhaustive set of mutually exclusive events must sum to 1).

Finally, framing effects have been found demonstrating that people can be risk-averse in one context but risk-seeking in another. The best-known of these are described in Prospect Theory, which holds that people generally are risk-averse under potential gains but risk-seeking under potential losses. Some researchers have presented evidence that people's risk attitudes can differ depending on substantive domains (e.g., recreation versus finance), whether the risk was voluntarily undertaken, and who may bear the consequences.

## B. Explanations of Probability Judgments

Accounts of and explanations for probability judgments focus on three main topics: Omissions and neglect (e.g., base-rate error), distortions or poor estimations, and priming or anchoring of

judgements. The "availability" and "representativeness" heuristics are primarily attempts to explain why people ignore base-rate information and logical constraints on compound probabilities. The availability heuristic is defined as assessing the probability of an event by the ease with which instances of it can be retrieved, imagined, or associated. The representativeness heuristic is the judgment of probability based on how prototypical an event is of its parent class or how similar it is to such a prototype. Both of these accounts have been criticized for being too vague and not connected to theories of human information processing.

Another type of account that focuses on distortions in probability judgments is a probability weighting model. The original version of Prospect Theory, for instance, posited that people over-weight low probabilities and under-weight high probabilities. Rank-dependent expected utility theory provides an alternative probability weighting model, in which the weights are determined by the rank-order of the consequences of an event, rather than by how extreme their probabilities are. Probabilities of extremely bad or good events tend to be over-weighted. Cumulative Prospect Theory incorporated the central innovation in the Rank-dependent framework, namely the transformation of the cumulative distribution function instead of the density function. A primary goal of both theories is retaining aspects of rationality (e.g., stochastic dominance) while being more descriptively accurate than SEU (e.g., accounting for people being risk-seeking in one condition and risk-averse in another).

A third kind of explanation focuses on priming or anchoring of probability judgments. An early example of such accounts is research beginning in the late 1970's on the "catch-all underestimation bias," a tendency to under-estimate the probability of events that are not explicitly described but instead bundled together into a catch-all category. Support Theory generalized this idea to a non-extensional account of probability judgments. The basic premise is that higher probability is given to events that can be "unpacked" into greater numbers of specific instances or subtypes.

Some recent work has attempted to account for the related phenomenon of "partition priming." A sample space partition concerns the division of the space into a set of exclusive events (e.g., two versus five possible events). Given such a partition of K possible events and no other information, people invoke the principle of indifference to anchor their probability estimates of each event on 1/K. Experimenters have found that even when a "correct" partition exists, people can be primed with an alternative partition (J alternatives, say) to anchor around 1/J instead of 1/K.

### C. Judgment Research on Nonprobabilistic Uncertainty

There is a scattered literature exploring the psychology of human responses to nonprobabilistic kinds of uncertainty. These include delay (as in delayed outcomes), ambiguity and, more recently, conflict and state space ignorance. Concurrently, there are debates over whether people respond to these alternative kinds of uncertainty just as they do to probabilistic uncertainty or as if these are truly distinct varieties. The following criteria have been proposed for distinguishing among kinds of uncertainty:

1. Normative: Can a case be made that a rational agent would equate one "kind" of uncertainty with another versus distinguishing between them?
2. Behavioral/consequentialis*t*: Does one "kind" influence responses independently of another "kind"?
3. Correlational/predictive: Are orientations towards one "kind" correlated with orientations towards another? Do different variables predict one kind than those predicting another?

4. Socio-cultural: Do social or cultural norms distinguish one "kind" from another?
5. Neurological: Are different structures in the brain entrained by different "kinds?" Does damage to one structure disable people from dealing with one "kind" but still allow them to deal with another?

We shall consider delay first. Behavioral studies of choice under uncertainty operationalize uncertainty in two ways: Reward variability and reward delay. The link between reward variability and probabilistic uncertainty is straightforward, but the link with delay perhaps is not quite as obvious. Generally, humans (and other animals) behave as if the consequential magnitude of an outcome is larger if it happens sooner than later. So good outcomes seem better and bad outcomes seem worse the sooner they occur. The corresponding analogy is that immediacies are certainties and delays are uncertainties. Thus, outcomes are discounted temporally in much the same way that they are discounted probabilistically. Economists have long maintained that temporal discounting is reasonable (or at least not irrational).

The strongest thesis for a direct analogy between delay and probability is that delay exerts the same kinds of influences that probability does. For example, temporal discounting predicts that people (and other animals) will be risk-averse for delayed gains and risk-seeking for delayed losses. Empirical evidence for this parallels findings of similar effects on risk-orientation due to probabilistic uncertainty as in Prospect Theory. That said, there also are recent studies and theoretical developments suggesting that inter-temporal effects on decisions do not always parallel the effects of probabilistic uncertainty, and research in this vein increasingly has taken a separate course.

Now let us turn to ambiguity. Ellsberg's classic paper showed that people can be influenced in whether to prefer betting on a gamble when they know the probabilities exactly to betting on a gamble when the probabilities are not known exactly, even though according to the standard SEU arguments they should have no preferences between those gambles. Usually people prefer known probabilities when they stand to gain by betting, but may prefer unknown probabilities when they face a prospect of loss. An obvious explanation for this preference pattern is that when probabilities are imprecise people adopt a pessimistic stance towards those probabilities but several other explanations have been promoted, including one that links attitudes towards ambiguity with those toward variability of consequences.

A few recent studies have extended the study of nonprobabilistic uncertainty to include uncertainty arising from conflicting information and from ignorance of the state space (i.e., not knowing about all possible outcomes). There is evidence that conflicting information is responded to as if it differs from other kinds of uncertainty, in that two ambiguous but agreeing messages from two sources are preferred over informationally equivalent precise but conflicting messages from two equally believable sources. People are conflict averse in the sense that they behave as if conflict is a more consequential kind of uncertainty than ambiguity. Likewise, there are empirical demonstrations that people disprefer state space ignorance to ambiguity. However, a few recent experiments have failed to replicate both sets of findings in their entirety. This is still a new and generally unexplored topic of research.

## D. Neuroeconomics

Since the mid-1990s, a confluence of research and theory from psychology, behavioral economics and neuroscience has generated the new subfield called "neuroeconomics." While still in its infancy, this area holds the potential to contribute substantially to our understanding of human decision

making under uncertainty. One of the most rapidly growing streams of neuroeconomic research focuses on how the brain processes uncertainty. This line of research began when single-unit recording studies in non-human primates indicated that neurons can convey information about the expected values of alternatives in a decisional task and neuronal activity can predict an individual's choices.

Neural imaging studies thus far suggest that the area most activated by uncertainty in stimuli is the frontomedian cortex, particularly when probabilities are involved. Some researchers also have observed that when uncertainty about outcomes cannot be analytically dealt with (e.g., under severe time constraint) then the lateral prefrontal and parietal regions become more active instead of the frontomedian cortical region.

Neuroeconomics and related developments in psychology were launched by two nearly simultaneous discoveries. One was the identification of a "reward center" in the brain, the key realization being that specific neural structures are recruited when people assess potential consequences of the alternatives in a choice-set. The other was the "somatic marker hypothesis," which proposes that emotions play an essential role in decision making. Up to the mid-1990's, affect was disregarded by decision researchers or considered a debilitating influence on decision quality. This view changed with the finding that neuro-trauma patients with damage to the frontomedian cortex but unimpaired reasoning ability nevertheless were unable to make high-quality judgments and decisions.

Around the same time, some researchers raised the possibility that "social" uncertainties may differ from uncertainties lacking a social component. The generative studies were conducted on neural activation while subjects play social dilemma games such as Prisoners Dilemma. An important finding is that activity in some cortical areas is increased during interactions with human opponents but not during similar interactions with computer-simulated opponents. This finding raises the possibility that human responses to uncertainty generated by other humans are distinct from responses to uncertainty from nonhuman sources.

Finally, recent studies comparing brain activity under risky versus ambiguous decisional tasks suggest that the regions activated may depend on the type of uncertainty. One such study found that ambiguity resulted in stronger activation in the laterial orbitofrontal cortex and the amygdala, while risk activated the striatum and precuneus. Behavioral performance on this task in orbitofrontal lesion patients corroborated these claims. Studies that compared risk and ambiguity also have found that preferences toward different types of uncertainty correlate with activation in different brain regions. For instance, activation of the posterior parietal cortex was predicted by risk preference, whereas activation in the lateral prefrontal cortex was predicted by ambiguity preference.

Evidence that different neural structures are activated to deal with different kinds of uncertainty indicates that the "kinds" are distinct in ways that do not depend entirely on cultural or social factors. Thus, this line of research can fill gaps in our understanding of how and why people think and act as if there are different forms of uncertainty.

## III. Social Constructions of Uncertainty

Up to this point, we have dealt exclusively with theories and studies of uncertainty that are asocial. These theories implicitly treat uncertainty as if its source is external or intra-subjective. Another tradition approaches uncertainty as being socially constructed. This section deals with that

tradition. First, however, we must dispense with a blind-spot concerning uncertainty and its effects. Most popular conceptions of uncertainty have a negative cast to them (e.g., uncertainty is impotence whereas knowledge is power). Of course, there are excellent reasons in many circumstances to be negatively disposed towards uncertainty. Nevertheless, uncertainty can motivate people positively as well as negatively. People find uses for uncertainty and do not always want to be rid of it. Indeed, they can be motivated to create uncertainty, not only for others but for themselves as well. Contrary to the view of ignorance and uncertainty as primarily negative, human engagement with ignorance or uncertainty is almost always a mixed-motive enterprise.

### A. Socially Constructing the Unknown

It may be very difficult to know anything directly about our own or anyone else's ignorance, but it is not as hard to find out about people's representations and accounts of ignorance. Moreover, those representations and accounts are important because ignorance, like knowledge, is in large part socially constructed. Most of the literature on uncertainty in disciplines such as economics, psychology, and (to a lesser extent) sociology presupposes agreement among all stakeholders on what is known and what is not known. Yet it seems obvious that the behavior of a dugong in waters off Cape York Australia will convey rather different "information" to a marine biologist and a Torres Strait Island fisherman. They might even agree that each "knows" different things about dugongs. But on some points they may dispute each other's knowledge and/or ignorance claims, and part of the basis for those disputes will be what "knowledge" or "ignorance" can consist of, and indeed what can and cannot be "known."

Everyday ideas about the unknown come from two sources: commonsense realism, and commonsense sociality. Commonsense realism encompasses everything we believe or think about how the non-social world works, including sacred as well as profane domains. Commonsense sociality refers to our beliefs about the social world and includes our theories of mind. Both kinds of common sense are essentially realist. Regardless of the ontological or epistemological positions adopted by scholars and researchers, many laypersons are ontological realists.

Commonsense ontological realism enables us to understand many of the uses people have for uncertainty and how they go about creating and maintaining it or responding to it. The backdrop most of the time includes the assumption that there is an independent reality that provides the true state of any conceivable unknown. For example, it makes no sense to decide whether or not one would like to know the date and manner of one's demise unless one believes that such things are preordained and therefore knowable. A similar basis underpins the economics of attention, the social control of curiosity, and other pertinent social norms and cultural practices governing who is supposed to know what and when they are supposed to know it.

### B. Ignorance, Uncertainty and Social Capital

Until fairly recently, the social sciences widely shared a "Pollyanna" perspective, in which the default assumption was that unshared knowledge, miscommunication and misunderstanding are pathological and in properly functioning social settings would be absent or eliminated. Some early dissidents from this perspective observed that many important kinds of social interactions and arrangements would be impossible without some unshared perceptions, omissions, secrets, and even deception by the participants. Others pointed to the ways in which unshared information and uncertainty are arranged and manipulated to establish or maintain power relations. For instance, research into the tobacco industry's efforts to manufacture doubt about the hazards of tobacco presents an exemplary case-study of the use of pseudo-science by an industrial giant to protect and

expand its investments. In this section we review some of the major uses of ignorance and uncertainty and their roles in social life.

Ignorance and uncertainty underpin certain forms of social capital. Four examples are specialized knowledge, privacy, trust, and politeness. The first two exemplify multilaterally negotiated ignorance arrangements as opposed to unilateral ones such as secrecy or deceit. The second pair, trust and politeness, are examples of social relations and modes of social conduct that mandate or even require ignorance.

Specialization is a social ignorance arrangement. Aside from its obvious basis in cognitive limitations and expanding knowledge-bases, specialization is an example of risk-spreading in three respects. First, no participant has to take on all of the risks of direct learning (versus vicarious learning which is less risky). Second, the risk of being ignorant about crucial matters is spread by diversifying ignorance. Third, the risks associated with the consequences of bearing knowledge (e.g. responsibility or culpability) also are diversified.

Likewise, privacy also is a socially mandated arrangement involving voluntarily imposed uncertainty and ignorance. Privacy often has been construed as control over access by others to information, mainly about the self. The most common motives for privacy are quite obvious, amounting to freedom from surveillance and exploitation.

There is widespread agreement among scholars that trust carries with it some form of risk or vulnerability. An important component of that risk is a requirement that the truster remain partially ignorant about the trustee. Trust relationships (e.g. friendships) entail a specific kind of privacy. If a person believes another is monitoring them or insisting that they self-disclose or account for their actions, that person will infer that the other does not trust them.

Polite or civil social interaction is another example of social relations that depend on ignorance. In polite conversation, conversationalists do not expect to deal in the truth, the whole truth, and nothing but the truth. Polite conversational strategies include disinformation (e.g. presenting a false impression of approval) and referential abbreviation (particularly vagueness and ambiguity or even outright omission, as in tactful utterances).

The literature on organizations and management has long given uncertainty a prominent place, although the treatment of "uncertainty" itself has been rather muddled. Classical frameworks for management science during the 1950s and 1960s advised managers to eliminate or absorb uncertainty. The most popular remedies included buffering, smoothing, forecasting, and various forms of strategic planning. These remedies primarily amounted to formulating plans to weather uncertain times and/or strategies for dampening fluctuations in consequences to the organization.

Most of the early findings in studies of how organizations deal with uncertainty could be summed up in the phrase "uncertainty avoidance." In addition to protecting the organization, motives for avoiding uncertainty included maintaining control and avoiding discreditation, adverse publicity, or controversy.

The 1970s and 1980s saw a more tolerant view of uncertainty in this literature. Evidence began to emerge that not all managers were risk-averse. Some high-performing managers were found to strategically select uncertain environments in which they could have a competitive edge or scope for entrepreneurship. Likewise, some studies revealed strategies employed by organizations to increase uncertainty for competitors in order to gain an advantage. Finally, critics of conventional control and regulation practices pointed out that tolerance of ignorance and uncertainty has potential benefits

for organizations, in the form of a local culture of innovation and entrepreneurship, as well as the kinds of social capital discussed earlier.

### C. Risk, Uncertainty and Public Culture

Research on risk perception arose during the 1970s, mainly in response to environmental concerns in Western nations. Much of the initial research was conducted by social and cognitive psychologists, with anthropology, sociology, and allied fields becoming involved during the 1980's and 1990's. There has been relatively little communication or integration between the cognitive psychological and socio-cultural approaches to this topic.

Two widely debated socio-cultural approaches to risk emerged during the 1990s. The first uses a "worldview" concept, positing that human attitudes towards risk and danger vary systematically according to cultural orientations, assumed to be individualist, fatalist, hierarchist or egalitarian. These orientations are held to strongly influence people's risk responses as well as attitudes towards the environment.

The second approach invokes the concept of a "risk society." The central claim is that modern technological developments have resulted in the emergence of new all-pervasive and invisible risks, also characterized as beyond the ken of laypeople. The focus of the "risk society" perspective is on deep and globalized forms of uncertainty and ignorance, arising from major technical and environmental risks (e.g., climate change, pollution, or mass extinctions) and how they have transformed the social landscape in terms of opportunities, threats, benefits and costs.

A third approach that links psychological and socio-cultural approaches is the social amplification of risk framework. The primary subject of this approach is to explain why particular risks become a focus of concern in society while others are ignored. This framework does not deny the reality of hazards but investigates how these are transformed in the public consciousness via their amplification or diminution by psychological and socio-cultural processes.

Somewhat related to the social amplification of risk framework is a critical literature that has emerged in the past decade as commentary on the increasingly risk-averse and litigious orientation of some Western societies. Writers and researchers in this vein have documented how risk and blameworthiness have become strongly linked under the rubric of democratic ideals such as accountability and transparency.

### D. Managing Uncertainty: Tradeoffs and Dilemmas

A crucial mistake in many perspectives that privilege knowledge over ignorance is the failure to realize that knowledge seeking and possession are not costless. The early literature on foraging behavior is pioneering in this regard, taking into account the energy and time costs entailed for an organism to try its luck in a different patch from the one it is familiar with. Information seeking and processing takes time, effort, and cognitive resources. Information seeking also can incur social costs. Directly interrogating someone, for example, is socially inappropriate or risky in many circumstances and prohibitively so in some cultures if the subject of interrogation has sufficiently high status.

Let us consider the tradeoffs involved in possessing information and knowledge, starting at the cognitive level. Ignoramuses are not always worse off than knowledgeable folk; in fact it can be demonstrated that under some conditions they are better off. Imagine for a moment that humans were endowed with the ability and a compulsion to indiscriminately absorb all information that came their way and retain all of it for a lifetime. It is well known that higher cognitive functions such

as abstraction or even mere classification would be extremely difficult. Information acquired decades ago would be as vividly recalled as information acquired seconds ago, so older memories would interfere with more recent and usually more relevant recollections. Thus, forgetting is just as important as remembering for adaptively selective information processing. In effect, memory behaves as if it is betting that the less frequently and recently a piece of information has been retrieved, the less likely it is to be needed and therefore the better off memory is without it.

Recent psychological research the recognition and fluency heuristics, both of which require partial ignorance, also are instructive. To understand the recognition heuristic, consider the question: "Which city has the larger population, Pasadena (California), or Pasadena (Maryland)?" If we do not know the populations of those two cities then we must rely on something else we know about them. The recognition heuristic says that if we recognize one city (most likely Pasadena, California) and not the other then we choose the recognised city. In this case we would make the correct choice (as I am writing this, Pasadena California contains about 145,000 people whereas Pasadena Maryland has about 12,000). Several studies have demonstrated that a greater number of correct choices (e.g., which of a pair of German cities has the greater population) can be made by ignorant decision makers (e.g., American university students) than by more knowledgeable decision makers (e.g., German citizens). The fluency heuristic is quite similar, stipulating that the city that is more fluently or rapidly recalled will be the one selected.

However, gaining an appreciation of the mixed-motive nature of engagement with ignorance and uncertainty, there is no substitute for examining some examples of real-world tradeoffs and dilemmas.

- "Collingridge's Dilemma" actually is a tradeoff. The less well-entrenched a system is and the shorter the time it has been operating, the more easily and inexpensively it can be changed; but the greater is our ignorance of its likely effects or problems. By the time ignorance of those effects has been reduced, it is too expensive and difficult to change the system. In this tradeoff, time is both knowledge and money.
- The "info-glut" dilemma is a genuine dilemma of the common-pool resource kind. Any stakeholder with an educational or persuasive interest will wish to broadcast its message in a public forum. Too many messages in an unregulated forum, however, may result in the public tuning out messages altogether. The scarce resource in this case is not information or knowledge, but attention.
- "Mattera's Dilemma" is an example of a conundrum in social regulation that has both tradeoff and dilemmatic components. The tradeoff arises from the fact that a regulatory climate favoring creativity and entrepreneurship requires the toleration of ignorance in the service of freedom. Insistence on full knowledge and control eliminates the latitude needed for creativity and entrepreneurship. The dilemmatic component arises from the fact that the greater the attempts to regulate behavior, the more reactive people become and the more they attempt to generate ignorance in the would-be controllers by withholding information or giving false information. If both parties pursue their self-interests then the end result is a system of constraints and controls built on disinformation.
- The "indemnity" dilemma is a mixture of a collective tradeoff and a public goods dilemma. Play, games, fun, volunteering, and various other public goods require at least some risk-taking. However, a risk-averse public, aided by opportunistic lawyers and profit-oriented

insurers, can create a litigious market in which public goods like fun and voluntarism are unaffordable or simply outlawed.

In conclusion, the roles played by knowledge and ignorance are not merely mirror-images of one another. Moreover, ignorance and uncertainty are neither negative nor marginal aspects of the human condition. They are essential to what makes us human.

**Cross References**

Cognitive bias, Decision making, Judgment, Meta-cognition, Neuroeconomics

**Further Reading**


Bammer, G. and Smithson, M. (Eds.) (2008). Uncertainty and risk: Multidisciplinary perspectives. London: Earthscan.

Baron, J. (2008). Thinking and deciding (4th Edition). Cambridge: Cambridge University Press.

Beck, U. (1999). *World risk society*. Oxford: Polity Press.

Black, M. (1937). Vagueness: An exercise in logical analysis. Philosophy of Science, 4, 427-455.

Damasio, A.R. (1994). Descartes' error: Emotion, reason and the human brain. New York: Putnam.

Furedi, F. (2002). Culture of fear (Revised Edition). London: Continuum.

Gigerenzer, G., Todd, P.M., and the ABC Research Group (1999). Simple heuristics that make us smart. London: Oxford University Press.

Knorr-Cetina, K. (1999). Epistemic cultures: How the sciences make knowledge. Cambridge, MA: Harvard University Press.

Lempert, R., Popper, S. and Bankes, S. (2002). Confronting surprise. Social Science Computer Review, 20, 420-440.

Nickerson, R. S. (1998). Confirmation bias: a ubiquitous phenomenon in many guises. Review of General Psychology, 2, 175-220.

Pollack, H. N. (2003). Uncertain science … uncertain world. Cambridge: Cambridge University Press.

Proctor, R. N. (1995). Cancer Wars: How Politics Shapes What We Know and Don't Know about Cancer. New York: Basic Books.

Smithson, M. (1989). Ignorance and Uncertainty: Emerging Paradigms. Cognitive Science Series. New York: Springer Verlag.

Smithson, M. (2008). Social theories of ignorance. In R. Proctor and L. Schiebinger (Eds.), Agnotology: The cultural production of ignorance. Stanford, CA: Stanford University Press.

Stanovich, K.E. (1999). Who is rational? Mahwah, NJ: Lawrence Erlbaum.


**Author Biography and Photograph**

Michael Smithson is a Professor in the Department of Psychology at The Australian National University in Canberra, and received his PhD from the University of Oregon. He is the author of Confidence Intervals (2003), Statistics with Confidence (2000), Ignorance and Uncertainty (1989), and Fuzzy Set Analysis for the Behavioral and Social Sciences (1987), co-author of Fuzzy Set Theory: Applications in the Social Sciences (2006), and co-editor of Uncertainty and Risk: Multidisciplinary Perspectives (2008) and

Resolving Social Dilemmas: Dynamic, Structural, and Intergroup Aspects (1999). His other publications include more than 100 refereed journal articles and book chapters. His primary research interests are in judgment and decision making under uncertainty, social dilemmas, and quantitative methods for the social sciences.